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Hidden design: An inquiry into the design of inclusive building environments and digital interface design for the vision impaired☆

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Abstract. This study aims to answer the question of what can architects and electronic and computer engineers offer to people with vision impairment? This research project is being undertaken jointly at the Faculty of Architecture, Landscape and Visual Arts—University of Western Australia and the Department of Electrical and Computer Engineering at Curtin University of Technology. The study demonstrates the processes of architects and electronic computer engineers' work with vision impaired people. This research will examine how architects and electronic computer engineers meet the needs of the vision impaired within the area of learning environments. By being involved in a project for the creation of a revolutionary new building at the Association for the Blind of Western Australia and working under the supervision of an architect who has had over thirty years experience in the areas of aging and sensory loss, will assist in the study of how to meet the needs of vision impaired people in their building environments. Participation in the Cisco Network Academy Program with the vision impaired students at Curtin University will be vital and explain the different ways of learning and the interaction of vision impaired students with their educational technology. This will become a good source to experts in a variety of fields, who work with the vision impaired so as to be able to study their reaction to new technology.

Keywords: Building environment; Computer technology; Vision impairment; Wayfinding systems; Tactile graphic

☆ Constituent of this paper is part of a study "HIDDEN DESIGN: Research into existing educational environments and aids. Improving the educational environment for people with vision impairment by investigation of the learning processes, the perception and interaction of vision impaired people with their environment and technology".

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1. Introduction

Universal design is aimed at allowing design for people with disability to become accessible. Many vision impaired people spend large amounts of their time in learning and dealing with new technology. In this research, Architects and Electronic & Computer Engineers work on projects for the vision impaired in the area of educational environment. There is a surprising lack of knowledge-exchange between these two disciplines, both of whom are crucially involved in the delivery of environments for vision impaired. As a result, this study will demonstrate the collaboration of their work in the field of educational environment for vision impaired people.

This study is aimed at the investigation of the creation and design of an educational environment and aids that are suitable for people who are vision impaired. It will allow many architects, designers, electronic computer engineers and people in other areas to understand the best way of creating appropriate educational environments and aids for people with vision impairment. A further objective is to demonstrate the processes of architects and electronic computer engineers' work with vision impaired people in the area of educational environment. This research will examine how the two groups meet the needs of the vision impaired within the area of educational environment.

2. Method

1. Survey of literature
   Reviewrecent research from 39 articles in Architecture and digital interface design for visually impaired, specifically focused towards:
   1.1 Building environment and architecture for the visually impaired and blindness
   1.2 Wayfinding systems
   1.3 Tactile communication
2. Evaluation of ongoing projects
   Recent research at the Association for the Blind of Western Australia and Electrical and the Computer Engineering School at Curtin University, specifically focus on
   2.1 Architecture's project
   Working with the architect on the project of creating an accessible building environment for the new building at the Association for the Blind of Western Australia.
   2.2 Engineering's project
   2.2.1 E-Learning Class (Cisco Network Academy Program for vision impaired and blindness)
   2.2.2 Creation of learning aids.
   2.2.3 Creating learning environments and access to University campus projects.

3. Results and discussion

Architects (outside the classroom)

1. Creating a comfortable environment for people with vision impairment
2. Making building environment become more accessible and inclusive

3. Barrier-free building environment.
4. Designing a safe, enabling and functional environment, using signage such as tactile information, Braille, nomad technique and the language of the building.
5. Universal design principles, using passive sensory principles combined with technology.
6. Designing an accessible building environment and space, so that vision impaired people can travel independently, using wayfinding technology such as talking signs, audio signs, infrared signage, sensory cues.

Electronic and computer engineers (inside the classroom)

1. Creating more useable technology.
2. Creating suitable computer, learning technology aids and adaptive technology.
3. Providing easy access to learning aids and computers.
4. Designing the learning aids and equipment, using tactile techniques such as peg board, tactile display, and Braille equipment.

4. Discussion

Using adaptive technology in an educational environment (Wayfinding technology, computer technology), benefits all, architects, electronic computer engineers and vision impaired people. Both architects and electronic computer engineers employ the use of technology in their educational environment. The use of wayfinding technology (built environment) and adaptive technology (learning aids) will be of benefit for students by providing easier access to the built environment as well as improved technology in the learning aids. The collaboration of Architects and Electronic computer engineers' work can be viewed in the following extracts:

1. **Design the products and environment to be usable.** In an article "Technology for visually impaired" the writer states that "Technology can be valuable for people with visual impairments, both as a tool for learning and communication and for providing visual stimulation" [1] Electronic computer engineers who provide the educational technology must consider that the special electronic equipment, computer, software and hardware products need to be specifically designed for people with vision impairment. In the article "Effective classroom adaptations for students with visual impairment" Cox and Dykes [2] state that "Any visual materials used in classrooms need to be adapted for use by students who do not have visual skills required for the task. Charts, models, maps and graphs will have greater educational value for students with visual impairments if they can be "read" using the sense of touch." Tactile graphic such as peg board, tactile display and Braille display is a useful learning aid for the vision impaired; architects can apply the knowledge of designing tactile graphics to assist the electronic computer engineers in terms of designing accessible learning equipment for the vision impaired.
2. **Combining and using adaptive technology within a building environment for the benefit of both the architect and vision impaired student.** "Whist good mobility

training can enable the user to move safely, good building design and good environment design can make this process easier."[3] According to Whitney, the good building design and environment can make buildings easier to use by vision impaired and blindness. Electronic computer engineers take the part of providing the knowledge of technology to the architect in the creation of an accessible building environment. The use of technology in the building environment, for instance, "Remote infrared audible signs" has been discussed in the final report of U.S. Architectural & Transportation Barriers Compliance Board [4] in 2001. In the report, it states that "Remote infrared audible signs have been found to be a particularly effective means to make wayfinding information accessible to person who is blind or who have other disabilities." As a result, the architects who provide wayfinding and navigation can make the building become accessible by the use of technology in the wayfinding system. The result being that vision impaired students can find their way and travel independently in the building environment.

3. **Designing effective learning environments.** "An appropriate working environment is important for people with vision impairments. Correct lighting and good working posture can make it easier for them to use any remaining vision effectively. This is particularly important for school situations where pupils may be reluctant to express their needs." [1] The research teaches us that with the provision of an appropriate environment for people with vision impairment, improved learning is stimulated. The architectural role is therefore aimed at creating the design in an inclusive environment, allowing for engineers to design work aids for the vision impaired. Designing an inclusive learning environment (Architecture) is a first step towards an effective and functioning classroom which will benefit both engineers and students alike.

5. Conclusion

From the proposed study it should create opportunity to advance or create as well as improve current methods in assisting the visually impaired. The objective is to identify ways that may offer scope for improvement as discovered by the observers (architect, engineer, and or a project leader) as well as students.

As a result, the study will likely require architects along with electrical computer engineers to create new designs to assist in improving educational environments and teaching aids as learned from the study.

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